



Attorney Docket No. 2000.16

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of:  
Runkle et al.

Group Art Unit: 1732

Serial No. 09/851,242

Examiner: Stefan Staicovici

Filed: May 08, 2001

For: METHOD FOR MAKING A HOLLOW FIBER MEMBRANE CONTACTOR

APPEAL BRIEF

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Commissioner for Patents  
P. O. Box 1450  
Alexandria, VA 22313-1450

Dear Sir:

This Appeal Brief is filed in reply to the Office Action  
mailed September 23, 2003 (Paper No. 19) and after the Notice of  
Appeal filed on December 23, 2003.

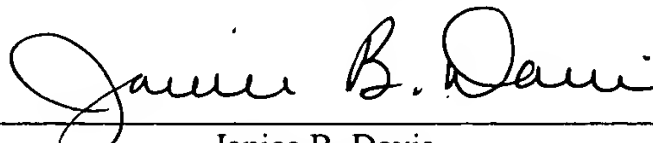
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I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient  
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Janice B. Davis

This Brief is transmitted in triplicate.

1. REAL PARTY IN INTEREST

The real party in interest is Celgard Inc., the assignee of record in the instant application.

2. RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences.

3. STATUS OF THE CLAIMS

Claims 1-2, 4-5, 16-19, and 21-27 are the subject of this appeal. Claims 3, 20, and 28 are canceled. Claims 6-15 are withdrawn from consideration in view of a restriction requirement.

4. STATUS OF AMENDMENTS

Applicant has filed an Amendment After Final Rejection to cancel Claims 20 and 28.

5. SUMMARY OF THE INVENTION

The following is a concise explanation of the invention defined in the claims. The instant invention teaches a method for making a hollow fiber membrane contactor. Claim 1 recites the method of making hollow fiber membrane contactor as comprising the following steps: (1) winding a hollow fiber fabric 16 around a

center tube 12, Fig. 2; (2) potting 36 the fabric 16 and the tube 12 together, Fig. 2; (3) forming thereby a unitized structure; (4) placing the structure into a shell 20, Fig. 3; (5) second mold potting the structure and the shell 20 together by injecting a potting material into a space between the structure and the shell, Fig. 3; (6) and forming thereby a cartridge. In Claim 4, the method of making hollow fiber membrane contactor may, further, include the step of (7) heat-treating the cartridge.

## 6. ISSUES

First, whether Claims 1-2, 4-5, 19 are obvious under 35 U.S.C. 103(a) over U.S. Patent No. 5,186,832 ("*Mancusi*") in view of U.S. Patent No. 4,800,019 ("*Bikson*").

Second, whether Claims 16-18 are obvious under 35 U.S.C. 103(a) over U.S. Patent No. 5,186,832 ("*Mancusi*") in view of U.S. Patent No. 4,800,019 ("*Bikson*"), and in further view of U.S. Patent No. 4,961,760 ("*Caskey*").

Third, whether Claims 1-2, 4-5, 16, and 18-19 are obvious under 35 U.S.C. 103(a) over U.S. Patent No. 5,284,584 ("*Huang*") in view of U.S. Patent No. 5,186,832 ("*Mancusi*"), and in further view of U.S. Patent No. 4,800,019 ("*Bikson*").

Fourth, whether Claim 17 is obvious under 35 U.S.C. 103(a) over U.S. Patent No. 5,284,584 ("*Huang*") in view of U.S. Patent No. 5,186,832 ("*Mancusi*"), and in further view of U.S. Patent No. 4,800,019 ("*Bikson*") and U.S. Patent No. 4,961,760 ("*Caskey*").

Fifth, whether Claims 21-23, and 27 are obvious under 35 U.S.C. 103(a) over U.S. Patent No. 5,186,832 ("*Mancusi*") in view of U.S. Patent No. 4,800,019 ("*Bikson*"), and in further view of Applicants' admitted prior art.

Sixth, whether Claims 24-26 are obvious under 35 U.S.C. 103(a) over U.S. Patent No. 5,186,832 ("*Mancusi*") in view of U.S. Patent No. 4,800,019 ("*Bikson*"), and in further view of Applicants' admitted prior art and U.S. Patent No. 4,961,760 ("*Caskey*").

Seventh, whether Claims 21-24 and 26-27 are obvious under 35 U.S.C. 103(a) over U.S. Patent No. 5,284,584 ("*Huang*") in view of U.S. Patent No. 5,186,832 ("*Mancusi*"), and in further view of U.S. Patent No. 4,800,019 ("*Bikson*") and Applicants' admitted prior art.

Eighth, whether Claim 25 is obvious under 35 U.S.C. 103(a) over U.S. Patent No. 5,284,584 ("*Huang*") in view of U.S. Patent No. 5,186,832 ("*Mancusi*"), and in further view of U.S. Patent No. 4,800,019 ("*Bikson*") and Applicants' admitted prior art.

## **7. GROUPING OF THE CLAIMS**

Claims 1-2, and 16-19 stand together as a group. Claims 4-5 stand together as a group. Claims 21-27 stand together as a group.

## **8. ARGUMENT**

Claims 1-2, 4-5, 16-19, and 21-27, for the reasons explained hereinafter, are not obvious under 35 U.S.C. 103(a). Thus, the above-mentioned 103 rejections are improper, and they must be removed. The errors made by the Examiner are discussed after a discussion of the invention and the cited references.

### **a. THE INVENTION**

The instant invention is directed to a method of making a hollow fiber membrane contactor, which comprises two potting steps: a first potting step, and a second potting step, described hereinbelow in detail. These two potting steps are quintessential in formation of a seal, which is capable of overcoming the problems arising from potting shrinkage, specifically, in contactors with a diameter greater than 10 inches. Referring to instant specification and figures 2-4, the manufacture of the hollow fiber membrane contactor is illustrated below.

In figure 2, shown below, "center tube 12 is used as a mandrel. Hollow fiber fabric 16 is wound around tube 12. Simultaneously with winding, potting resin beads 36 are laid at the lateral edges of fabric 16 and form tube sheets 18, i.e., the first or bead-potting step. Optionally, a bead 38 may also be laid between beads 36, thereby forming spacer 34. At the conclusion of this step, the potting is, preferably, a gelatinous solid 37 and the unitized structure is formed.

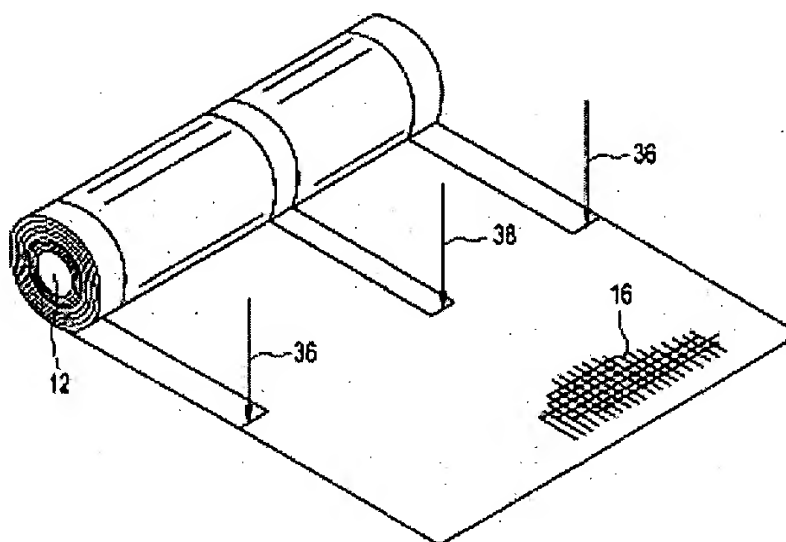


Fig.2

After the first potting step, the unitized structure is inserted into the shell 20. Shell 20 and the structure are inserted into a mold 42." (Specification, Page 7, Line 20 - Page 8 Line 6).

Referring to figure 3, "mold 42, preferably, consists of a part that engages shell 20, a center mold piece 44 that engages

tube 12, and potting injection ports 46. The mold thereby centers the unit within the shell." (Specification, Page 8, Lines 8-11).

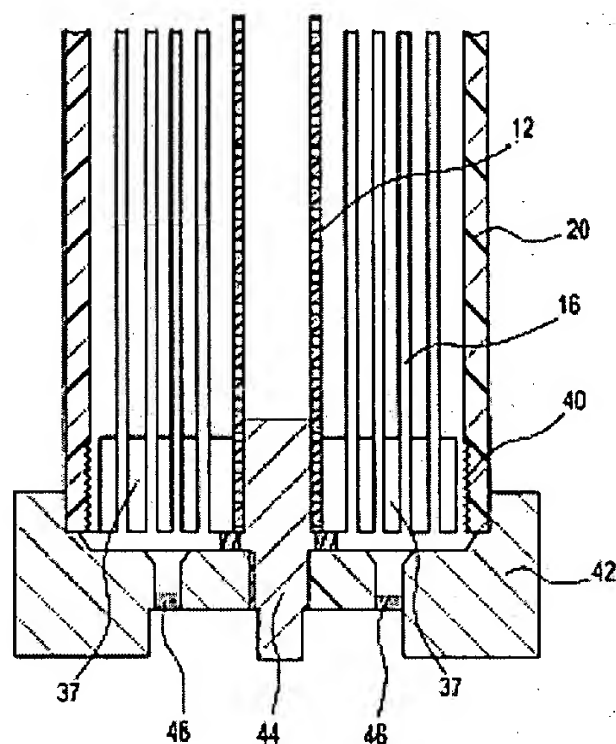


Fig. 3

Referring to figure 4, "a second potting material 48 is injected through the mold, into the space between shell 20 and solid 37, and thereby joins the shell to the unitized structure, i.e., the second or mold-potting step." (Specification, Page 8, Lines 13-18).

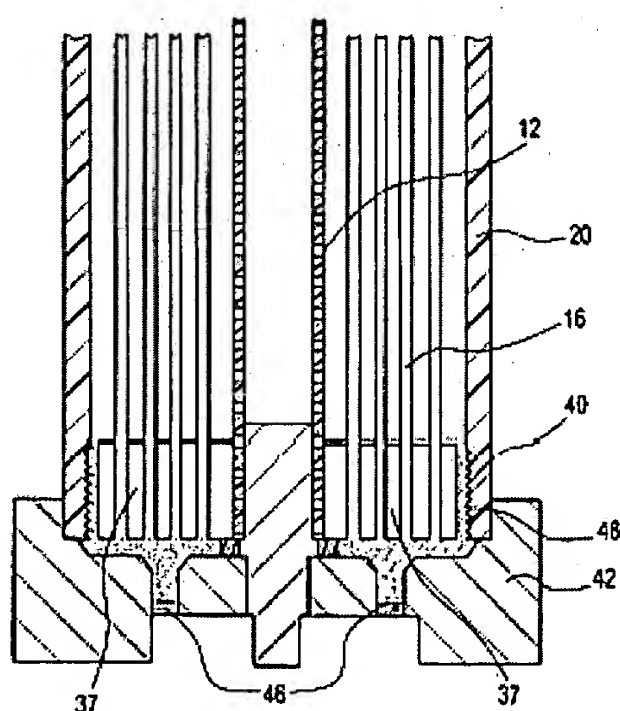


Fig. 4

"The potting resins are allowed to solidify. The cartridge is removed from the mold. The ends are, preferably, subjected to a rotary cut to open the end of the hollow fibers and to generate a planar cut surface that is perpendicular to the centerline of the cartridge." (Specification, Page 8, Lines 20-24).

"After the two potting steps described above, the cartridge is, preferably, heat-treated. Heat-treatment increases the thermal/mechanical integrity of the cartridge by reducing residual stress. Additionally, when an epoxy potting is used, this heat-treatment further cross-links and hardens the potting. Reduced stress lessens the occurrence of cracking at interfaces and joints." (Specification, Page 9, Lines 2-7).

According to the instant application, "although contactors with ten (10) inch diameter are commercially available, these contactors are difficult to seal because of potting shrinkage." (Specification, Page 2, Lines 10-13). The instant invention resolves the difficulties associated with formation of a seal between the tube sheets and the shell due to the potting shrinkage. Furthermore, as shown in Claim 21, the instant invention provides a hollow fiber membrane contactor with a diameter greater than six



inches while maintaining the integrity of the seal between the tube sheets and the shell.

b. CITED REFERENCES

U.S. Patent No. 5,186,832 ("*Mancusi*"), assigned to the real party in interest of the instant appeal, is directed to a spiral-type hollow fiber membrane fabric-containing cartridges and modules for separation and other phase contact applications. (Column 1, lines 13). According to *Mancusi*, (1) the hollow membrane fabric and integrally-bonded turbulence-promoting web is wound onto the surface of the hollow core mandrel to form a spirally-wound membrane bundle (Column 8, lines 44-47); (2) the two ends of the bundle are potted in resinous potting material serving to seal each of the bundle ends into a monolithic tube sheet and complete the cartridge (Column 9, lines 1-8); (3) one or both of the potted ends of the bundle are then trimmed so that the lumen ends of each hollow fiber at the trimmed end(s) will be exposed (Column 9, lines 14-17); (4) the potted bundle is fitted into a suitable housing to yield a module and facilitate operation (Column 9, lines 18-19); (5) the tube sheet(s) adjacent to the bundle end(s) with exposed lumens is(are) **sealed** to the interior of the housing, to positively prevent fluid flow between the shell side and the lumen side without passage through the membrane (Column 9, lines 23-27); and

(6) end cap means suitably shaped to seal each of the two open housing ends are provided (Column 9, lines 33-34).

Furthermore, according to *Mancusi*, cast-in-place modules can be made by the steps of: (1) starting with (a) a bundle prepared as discussed above, and (b) a conventional cast-in-place housing, which is generally made of plastic; (2) inserting the bundle into the housing; (3) potting both of the bundle ends after sealing the bundle ends with a potting cup clamped over each end of the housing; and (4) providing suitable end caps and ports. (Column 9, line 63 - Column 10, line 3).

However, *Mancusi* does not teach or suggest anything about employing a two potting steps method, as required by the instant invention to form a seal between the tube sheets and the shell. Furthermore, *Mancusi* does not teach or suggest anything about heat-treatment of the cartridge to cure the potting between the tube sheets and the shell in order to resolve the problems associated with the seal between the tube sheets and the shell, which is due to the shrinkage of the potting materials. Furthermore, the creation of seal between the tube sheets to the interior of the housing in *Mancusi* is, in fact, facilitated via the use of O-rings as shown in the declaration submitted by Charles J. Runkle (attached hereto as "Exhibit A").

U.S. Patent No. 4,800,019 ("*Bikson*") is directed to a method of producing a porous hollow semipermeable membrane device. (Column 3, lines 18-20). According to *Bikson*, one or both ends of a plurality or a bundle of porous hollow fibers is embedded or potted in a tube sheet. (Column 4, lines 48-51). According to *Bikson*, the end of the hollow fiber bundle is placed in a mold, and the mold is filled with the potting resin composition to form the tube sheets. (Column 4, lines 53-55). The tube sheet or potted portion of the module is subsequently heat treated by the process according to *Bikson*. (Column 4, lines 60-68). Heating is continued for a period of time sufficient to essentially densify the porous walls of the hollow fibers in the potted portion of the tube sheet. (Column 3, lines 28-30). As a consequence of this heat treatment, the hollow fiber in the tube sheet densifies and the bores of the portion of the hollow fibers embedded in the tube sheet now have a larger inside bore diameter than the inside bore diameter of the portion of the porous hollow fiber not embedded in the tube sheet. (Column 8, lines 27-33). In addition, the walls of the hollow fibers, embedded in the tube sheet, are now essentially fully dense and non-compressible. (Column 8, lines 33-36). The fibers will not shrink from the potting-fiber interface at operating pressures during fluid separation processes and there is essentially no leakage at the interface between the outside

surface wall of the hollow fibers and the tube sheet. (Column 8, lines 36-40). Also, because the inside diameter of the fiber bore openings has increased due to the hollow fiber wall densification, pressure drop through the bores in the tube sheet during fluid separation operation is lower. (Column 8, lines 40-44). Another advantage is that the opening of the fiber bore ends in the tube sheet is facilitated due to the larger bore openings present. (Column 8, lines 44-46).

However, *Bikson* does not teach or suggest anything about employing a two potting steps method, as required by the instant invention to form a seal between the tube sheets and the shell. Furthermore, *Bikson* does not teach or suggest anything about heat-treatment of the cartridge to cure the potting between the tube sheets and the shell in order to resolve the problems associated with the seal between the tube sheets and the shell, which is due to the shrinkage of the potting materials.

U.S. Patent No. 4,961,760 ("*Caskey*") is directed to hollow fiber membrane fluid separation device specially adapted for boreside feed. *Caskey* discloses that tube sheets may be made from a variety materials, i.e. epoxy, polyurethane, and acrylic resins. (Column 7, lines 40-43).

However, Caskey does not teach or suggest anything about employing a two potting steps method, as required by the instant invention to form a seal between the tube sheets and the shell. Furthermore, Caskey does not teach or suggest anything about heat-treatment of the cartridge to cure the potting between the tube sheets and the shell in order to resolve the problems associated with the seal between the tube sheets and the shell, which is due to the shrinkage of the potting materials.

U.S. Patent No. 5,284,584 ("*Huang*"), assigned to the real party in interest of the instant appeal, is directed to a method of fabricating a spiral-type hollow fiber membrane fabric-containing cartridge. (Column 4, lines 12-14). According to *Huang*, "(1) hollow fibers are fabricated into a fabric-like array; (2) the fabric-like array is wound onto the mandrel surface to form a spirally wound, cylindrical shape membrane bundle; (3) the ends of the membrane bundle is potted in resinous potting material serving to seal each of the bundle ends into a monolithic tube sheet; (4) the potted ends of the bundle is trimmed so that the lumen ends of each hollow fiber at the trim end is exposed; (5) potted bundle is fitted into a housing; and (6) the tube sheet(s) adjacent to the bundle end(s) with exposed lumens is(are) sealed to the cylindrical interior of the housing, to positively prevent fluid flow between

the shell side and the lumen side without passage through the membrane." (Column 7, line 6 - Column 9, line 16).

However, *Huang* does not teach or suggest anything about employing a two potting steps method, as required by the instant invention to form a seal between the tube sheets and the shell. Furthermore, *Huang* does not teach or suggest anything about heat-treatment of the cartridge to cure the potting between the tube sheets and the shell in order to resolve the problems associated with the seal between the tube sheets and the shell, which is due to the shrinkage of the potting materials. Furthermore, the creation of seal between the tube sheets to the interior of the housing in *Huang* is, in fact, facilitated via the use of O-rings as shown in the declaration submitted by Charles J. Runkle (attached hereto as "Exhibit A").

c. DISCUSSION OF THE EXAMINER'S ERROR

Claims 1-2, 4-5, 16-19, and 21-27 are not obvious under 35 U.S.C. 103(a) because the Examiner has failed to show a *prima facie* case of obviousness.

To reject claims in an application under section 103, an examiner must show a *prima facie* case of obviousness. *In re Deuel*,

51 F. 3d 1552, 1557 (Fed. Cir. 1995). All words in a claim must be considered in judging the patentability of that claim against prior art. *In re Wilson*, 424 F.2d 1382, 1385 (CCPA 1970). Furthermore, to establish a *prima facie* case of obviousness, the following three basic elements must be met: (1) there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings; (2) the prior art reference or references when combined must teach or suggest all the claim limitations; **and** (3) there must be a reasonable expectation of success. MPEP § 2143. In addition, if the proposed modification or combination of the prior art would change the principle operation of the prior art invention being modified, then teachings of the references are not sufficient to render the claims *prima facie* obvious. *In re Ratti*, 270 F.2d 810 (CCPA 1959). Finally, if an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F. 2d 1071 (Fed. Cir. 1988).

The Examiner has failed to show a *prima facie* case of obviousness for the reasons explained hereinafter.

With regard to the first issue, the Examiner has failed to show all of the elements required to establish a *prima facie* case of obviousness.

First, with regard to Claim 1, there is no suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify *Mancusi* or to combine the *Mancusi's* teachings with *Bikson's* teachings for the reasons explained hereinafter.

The instant invention is directed to a method of making a hollow fiber membrane which includes, as stated above, a two potting steps method, wherein a seal is formed between the structure and the shell via injecting a potting material into a space between the structure and the shell. The instant invention provides a solution to the shortcomings of the prior art, specifically, the instant invention minimizes the problems associated with the shrinkage arising from the solidification of the potting materials in the tube sheets. Therefore, the instant invention, as shown in Claim 21, facilitates the production of membrane contactors having a diameter of six (6) inches or more.

However, although *Mancusi*, as stated above, discloses that "the tube sheet(s) adjacent to the bundle end(s) with exposed



lumens is(are) **sealed** to the interior of the housing, *Mancusi* fails to teach or suggest anything about employing a two potting steps method, as required by the instant invention, to form a seal between the tube sheets and the shell. In fact, the creation of seal between the tube sheets to the interior of the housing in *Mancusi* is facilitated via the use of O-rings as shown in the declaration submitted by Charles J. Runkle (attached hereto as "Exhibit A").

Furthermore, *Bikson* only discloses mold potting in connection with forming the tube sheets (first potting); however, the Examiner has misconstrued *Bikson* to show that it teaches the formation of a seal between the tube sheets and the shell (second potting). There is no mention in *Bikson* about employing a two potting steps method, as required by the instant invention, to form a seal between the tube sheets and the shell. *Bikson* is simply directed to heat treatment of the tube sheets to densify the porous walls of the hollow fibers in the potted portion of the tube sheet in order to enlarge the diameter of the lumen portion of the fibers embedded in the tube sheets than the diameter of the lumen portion of the fibers not embedded in the tube sheets.

Similar to *Ex parte Levengood*, 28 USPQ 2D 1300 (Bd. Pat. App. & Inter., 1993), where the suggestion for examiner's combination

improperly stemmed from the applicant's disclosure, the suggestion for Examiner's combination of the prior art, with regard to the instant application, also stems from the Applicant's disclosure in the instant application. Although, *Mancusi* teaches the requirement for a seal between the tube sheets and the shell, and *Bikson* discloses the use of mold potting to form the tube sheets, there is no suggestions or motivations to modify *Mancusi*'s teachings or to combine *Mancusi*'s teachings with *Bikson*'s teachings, i.e. to employ a two potting steps method, as required by the instant invention, to form a seal between the tube sheets and the shell.

Therefore, Claim 1 is not obvious since all of the required elements to establish a *prima facie* case of obviousness has not been shown.

Second, with regard to Claim 1, the proposed combinations would change the principle of operation of *Mancusi*, sealing step via the use of O-rings, assuming, *arguendo*, *Mancusi* and *Bikson* are combinable. *Mancusi*, as shown in "Exhibit A," employs the use of O-rings to form the seal while the instant invention employs a two potting steps method to form a seal. Formation of a seal via O-rings is fundamentally different from formation of a seal via a two potting steps method. O-rings causes the shell to contract in order to form the seal while a two potting steps method forms the

seal via bonding. Therefore, the substitution of a two potting steps method as the means for forming the seal for O-rings would substantially change the principle operation of *Mancusi*; thus, the teachings of *Mancusi* and *Bikson* are not sufficient to render the instant claim obvious.

Third, with regard to claims 2, 4-5, 19, since Claim 1 is not obvious; then, Claims 2, 4-5, 19 are not obvious. Claims 2, 4-5, 19-20 are dependant claims from Claim 1. Furthermore, as mentioned hereinabove, if an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F. 2d 1071 (Fed. Cir. 1988). Therefore, Claims 2, 4-5, 19 are not obvious.

Fourth, with regard to Claim 4, Claim 4 also includes the heat treatment step in order to strengthen the seal between the tube sheets and the shell. According to instant invention, the heat treatment is a subsequent step to the two potting steps in order to strengthen the seal between the tube sheets and the shell. However, *Bikson*, as stated above, employs heat treatment after the first potting step in order to densify the walls of the hollow fibers, and to enlarge the diameter of the lumen of that portion of hollow fibers embedded in potting materials. Therefore, assuming, *arguendo*, *Mancusi* and *Bikson* are combinable, their teachings do not

teach or suggest all the claim limitations of Claim 4. Therefore, Claim 4 is not obvious.

With regard to the second issue, since Claim 1 is not obvious; then, Claims 16-18 are not obvious. Claim 16 is a dependant claim from Claim 1, and Claims 17 and 18 are dependant claims from Claim 16. Furthermore, as mentioned hereinabove, if an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F. 2d 1071 (Fed. Cir. 1988). Therefore, Claims 16-18 are not obvious.

With regard to the third issue, the Examiner has failed to show all of the elements required to establish a *prima facie* case of obviousness.

First, with regard to Claim 1, there is no suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify *Huang's* teachings or to combine *Huang's* teachings with the teachings of *Mancusi* and *Bikson* for the reasons explained hereinafter.

The instant invention, as mentioned hereinabove, is directed to a method of making a hollow fiber membrane which includes, as

stated above, a two potting steps method, wherein a seal is formed between the structure and the shell. The instant invention provides a solution to the shortcomings of the prior art, specifically, the instant invention minimizes the problems associated with the shrinkage arising from the solidification of the potting materials in the tube sheets. Therefore, the instant invention facilitates, as shown in Claim 21, the production of membrane contactors having a diameter of six (6) inches or more.

According to *Huang*, the tube sheet(s) adjacent to the bundle end(s) with exposed lumens is(are) sealed to the cylindrical interior of the housing, to positively prevent fluid flow between the shell side and the lumen side without passage through the membrane." (Column 7, line 6 - Column 9, line 16). However, *Huang* does not teach or suggest anything about employing a two potting steps method, as required by the instant invention, to form a seal between the tube sheets and the shell. In fact, the creation of seal between the tube sheets to the interior of the housing in *Huang* is facilitated via the use of O-rings as shown in the declaration submitted by Charles J. Runkle ("Exhibit A").

Furthermore, although *Mancusi*, as stated above, discloses that "the tube sheet(s) adjacent to the bundle end(s) with exposed lumens is(are) **sealed** to the interior of the housing, *Mancusi* fails

to teach or suggest anything about employing a two potting steps method, as required by the instant invention, to form a seal between the tube sheets and the shell. In fact, the creation of seal between the tube sheets to the interior of the housing in *Mancusi* is facilitated via the use of O-rings as shown in the declaration submitted by Charles J. Runkle ("Exhibit A").

In addition, *Bikson* only discloses mold potting in connection with forming the tube sheets (first potting); however, the Examiner has misconstrued *Bikson* to show that it teaches the formation a seal between the tube sheets and the shell (second potting). There is no mention in *Bikson* about employing a two potting steps method, as required by the instant invention, to form a seal between the tube sheets and the shell. *Bikson* is simply directed to heat treatment of the tube sheets to densify the porous walls of the hollow fibers in the potted portion of the tube sheet in order to enlarge the diameter of the lumen portion of the fibers embedded in the tube sheets than the diameter of the lumen portion of the fibers not embedded in the tube sheets.

Similar to *Ex parte Levengood*, 28 USPQ 2D 1300 (Bd. Pat. App. & Inter., 1993), where the suggestion for examiner's combination improperly stemmed from the applicant's disclosure, the suggestion for Examiner's combination of the prior art, with regard to the

instant application, also stems from the Applicant's disclosure in the instant application. Although, *Huang* and *Mancusi* disclose the requirement for a seal between the tube sheets and the shell, and *Bikson* discloses the use of mold potting to form the tube sheets, there is no suggestions or motivations to Modify *Huang's* teachings or to combine *Huang's* teachings with *Mancusi's* teachings and *Bikson's* teachings, i.e. to employ a two potting steps method, as required by the instant invention, to form a seal between the tube sheets and the shell.

Therefore, Claim 1 is not obvious since all of the required elements to establish a *prima facie* case of obviousness has not been shown.

Second , with regard to claims 2, 4-5, 16, 18-19, since Claim 1 is not obvious; then, Claims 2, 4-5, 16, 18-19 are not obvious. Claims 2, 4-5, 16, 18-19 are dependant claims from Claim 1. Furthermore, as mentioned hereinabove, if an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F. 2d 1071 (Fed. Cir. 1988). Therefore, Claims 2, 4-5, 16, 18-19 are not obvious.

Third, with regard to Claim 4 and Claim 5, Claim 4 and Claim 5 also include the heat treatment step in order to strengthen the

seal between the tube sheets and the shell. According to instant invention, the heat treatment is a subsequent step to the two potting steps method to strengthen the seal between the tube sheets and the shell. However, *Bikson*, as stated above, employs heat treatment after the first potting step in order to densify the walls of the hollow fibers, and to enlarge the diameter of the lumen of that portion of hollow fibers embedded in potting materials. Therefore, assuming, arguendo, *Mancusi* and *Bikson* are combinable, their teachings do not teach or suggest all the claim limitations of Claim 4 or Claim 5. Therefore, Claim 4 and Claim 5 are not obvious.

With regard to the fourth issue, since Claim 1 and Claim 16 are not obvious; then, Claim 17 is not obvious. Claim 16 is a dependant claim from Claim 1, and Claim 17 is a dependant claim from Claim 16. Furthermore, as mentioned hereinabove, if an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F. 2d 1071 (Fed. Cir. 1988). Therefore, Claim 17 is not obvious.

With regard to the fifth issue, Claims 21-23, and 27 are not obvious for the reasons stated herein below.



First, with regard to Claim 21, Claim 21 is further limited in scope than Claim 1; in Claim 21, the center tube has a diameter of 6 inches or more, and the first potting step is accomplished via bead potting. Therefore, for the reasons stated hereinabove with regard to Claim 1 in response to the first issue, Claim 21 is not obvious either.

Second, with regard to Claims 22-23, and 27, since Claim 21 is not obvious; then, Claims 22-23, and 27 are not obvious. Claims 22 and 27 are dependant claims from Claim 21, and Claim 23 is a dependant claim from Claim 22. Furthermore, as mentioned hereinabove, if an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F. 2d 1071 (Fed. Cir. 1988). Therefore, Claims 22-23, and 27 are not obvious.

With regard to sixth issue, since Claim 21 is not obvious; then, Claims 22-26 are not obvious. Claim 22 and 24 are dependant claims from Claim 21, and Claims 23, 25, and 26 are dependant claims from Claim 22 and 24. Furthermore, as mentioned hereinabove, if an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F. 2d 1071 (Fed. Cir. 1988). Therefore, Claims 22-26 are not obvious.

With regard to seventh issue, Claims 21-24, and 26-27 are not obvious for the reasons stated herein below.

First, with regard to Claim 21, Claim 21 is further limited in scope than Claim 1; in Claim 21, the center tube has a diameter of 6 inches or more, and the first potting step is accomplished via bead potting. Therefore, for the reasons stated hereinabove with regard to Claim 1 in response to the third issue, Claim 21 is not obvious either.

Second, with regard to Claims 22-24, and 26-27, since Claim 21 is not obvious; then, Claims 22-24, and 26-27 are not obvious. Claims 22, 24, and 27 are dependant claims from Claim 21, and Claims 23, and 26 are dependant claims from Claim 22, and 24, respectively. Furthermore, as mentioned hereinabove, if an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F. 2d 1071 (Fed. Cir. 1988). Therefore, Claims 22-24, and 26-27 are not obvious.

With regard to eighth issue, since Claim 21 and 24 are not obvious; then, Claim 25 is not obvious. Claim 24 is a dependant claim from Claim 21, and Claim 25 is a dependant claim from Claim

24. Furthermore, as mentioned hereinabove, if an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F. 2d 1071 (Fed. Cir. 1988). Therefore, Claims 25 is not obvious.

d. CONCLUSION

In view of the forgoing comments, Claims 1-2, 4-5, 16-19, and 21-27 are not obvious under 35 U.S.C. 103(a); therefore, the Applicant respectfully requests an early Notice of Allowance in the instant application.

Respectfully submitted,



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Docket No. 2000.16  
SERIAL NO. 09/851,242  
ART UNIT 1732

APPENDIX

1. A method of making a hollow fiber membrane contactor comprising the steps of:  
  
winding a hollow fiber fabric around a center tube,  
  
first potting the fabric and the tube together, forming thereby a unitized structure, placing the structure into a shell, second mold potting the structure and the shell together by injecting a potting material into a space between the structure and the shell, and forming thereby a cartridge.
2. The method of claim 1 wherein the first-mentioned potting being bead potting.
4. The method of claim 1 further comprising the step of heat-treating the cartridge.

5. The method of claim 4 wherein the heat-treating further comprises a first heat-treating and a second heat-treating.

16. The method of claim 1 wherein potting further comprises the first or the second potting with a material selected from the group consisting of thermosetting materials and thermoplastic materials.

17. The method of claim 16 wherein the thermosetting material being selected from the group consisting of epoxy and polyurethane.

18. The method of claim 16 wherein the thermoplastic material being selected from the group consisting of polyolefins and polyurethanes.

19. The method of claim 1 wherein placing the structure into a shell further comprises centering the structure in the shell.

21. A method of making a hollow fiber membrane contactor comprising the steps of:

winding a hollow fiber fabric around a center tube to a diameter of at least six inches,  
bead potting the fabric and the tube together,  
forming thereby a unitized structure,  
placing the structure into a shell,  
mold potting the structure and the shell together by injecting a potting material into a space between the structure and the shell, and  
forming thereby a cartridge.

22. The method of claim 21 further comprising the step of heat-treating the cartridge.

23. The method of claim 22 wherein the heat-treating further comprises a first heat-treating and a second heat-treating.

24. The method of claim 21 wherein bead or mold potting further comprises using a material selected from the group consisting of thermosetting materials and thermoplastic materials.

25. The method of claim 24 wherein the thermosetting material being selected from the group consisting of epoxy and polyurethane.

26. The method of claim 24 wherein the thermoplastic material being selected from the group consisting of polyolefins and polyurethanes.

27. The method of claim 21 wherein placing the structure into a shell further comprises centering the structure in the shell.

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## EXHIBIT A

Attorney Docket No. 2000.16

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:  
Runkle, et al

Art Unit: 1732

Serial No. 09/851,242

Examiner: S. Staicovici

Filed: May 8, 2001

For: HOLLOW FIBER MEMBRANE CONTACTOR  
AND METHOD FOR MAKING SAME

### DECLARATION UNDER RULE 132

I, Charles J. Runkle, declare:

1. I am a named inventor in the above captioned application.
2. I am also a named inventor in U.S. Patent Numbers 5,186,832 (Mancusi et al) and 5,284,584 (Huang et al) cited against the above captioned application.
3. In the instant application, Paper No. 6, page 4, paragraph 9, and page 6, paragraph 12, the Examiner states:  
  
"...., it should be noted that Mancusi et al ('832) specifically teach potting of the tube-sheets to the interior of the housing (see col. 9, lines 22-27)."
4. The Examiner's interpretation of that portion of Mancusi et al is incorrect.



5. The portion of Mancusi et al cited by the Examiner states:

"After the bundle is installed in the housing, the tube sheet(s) is (are) sealed to the interior of the housing, to positively prevent fluid flow between the shell side and the lumen side without passage through the membrane."

6. That portion does not refer to "potting the structure and the shell together."

7. That portion refers to the use of o-rings to form a seal.

8. The portion of Mancusi et al cited by the Examiner and set out in Paragraph 5 above appears in Huang et al at column 9, lines 11-16.

9. Therein, it is stated that the "bundle" is "sealed" to the "housing."

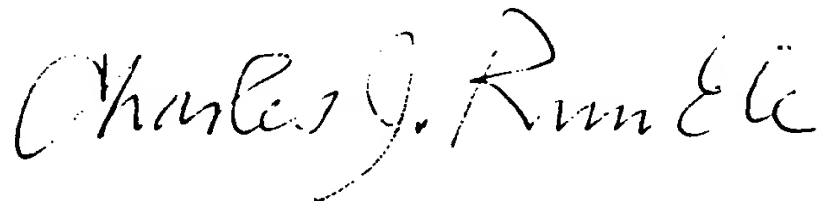
10. In that passage, "sealed" refers to the use of o-rings.

11. At Huang et al, column 21, lines 58-61 and Figure 6, it is shown that "sealing" refers to o-rings.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and that these statements were made

with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Respectfully submitted,

A handwritten signature in cursive script, reading "Charles J. Runkle". The signature is written in dark ink and is positioned above the printed name.

Charles J. Runkle

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Attorney Docket No. 2000.16

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of:  
Runkle et al.

Group Art Unit: 1732

Serial No. 09/851,242

Examiner: Stefan Staicovici

Filed: May 08, 2001

For: METHOD FOR MAKING A HOLLOW FIBER MEMBRANE CONTACTOR

APPEAL BRIEF

Mail Stop Appeal Brief-Patents  
Commissioner for Patents  
P. O. Box 1450  
Alexandria, VA 22313-1450

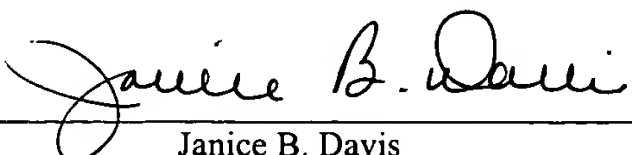
Dear Sir:

This Appeal Brief is filed in reply to the Office Action mailed September 23, 2003 (Paper No. 19) and after the Notice of Appeal filed on December 23, 2003.

The fees required under Sections 1.17(b) and 1.17(c) are paid pursuant to instructions on the accompanying Fee Transmittal Sheet which is provided in duplicate.

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, DC 20231, on January 28, 2004.

  
Janice B. Davis

This Brief is transmitted in triplicate.

1. REAL PARTY IN INTEREST

The real party in interest is Celgard Inc., the assignee of record in the instant application.

2. RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences.

3. STATUS OF THE CLAIMS

Claims 1-2, 4-5, 16-19, and 21-27 are the subject of this appeal. Claims 3, 20, and 28 are canceled. Claims 6-15 are withdrawn from consideration in view of a restriction requirement.

4. STATUS OF AMENDMENTS

Applicant has filed an Amendment After Final Rejection to cancel Claims 20 and 28.

5. SUMMARY OF THE INVENTION

The following is a concise explanation of the invention defined in the claims. The instant invention teaches a method for making a hollow fiber membrane contactor. Claim 1 recites the method of making hollow fiber membrane contactor as comprising the following steps: (1) winding a hollow fiber fabric 16 around a

center tube 12, Fig. 2; (2) potting 36 the fabric 16 and the tube 12 together, Fig. 2; (3) forming thereby a unitized structure; (4) placing the structure into a shell 20, Fig. 3; (5) second mold potting the structure and the shell 20 together by injecting a potting material into a space between the structure and the shell, Fig. 3; (6) and forming thereby a cartridge. In Claim 4, the method of making hollow fiber membrane contactor may, further, include the step of (7) heat-treating the cartridge.

## 6. ISSUES

First, whether Claims 1-2, 4-5, 19 are obvious under 35 U.S.C. 103(a) over U.S. Patent No. 5,186,832 ("*Mancusi*") in view of U.S. Patent No. 4,800,019 ("*Bikson*").

Second, whether Claims 16-18 are obvious under 35 U.S.C. 103(a) over U.S. Patent No. 5,186,832 ("*Mancusi*") in view of U.S. Patent No. 4,800,019 ("*Bikson*"), and in further view of U.S. Patent No. 4,961,760 ("*Caskey*").

Third, whether Claims 1-2, 4-5, 16, and 18-19 are obvious under 35 U.S.C. 103(a) over U.S. Patent No. 5,284,584 ("*Huang*") in view of U.S. Patent No. 5,186,832 ("*Mancusi*"), and in further view of U.S. Patent No. 4,800,019 ("*Bikson*").

Fourth, whether Claim 17 is obvious under 35 U.S.C. 103(a) over U.S. Patent No. 5,284,584 ("*Huang*") in view of U.S. Patent No. 5,186,832 ("*Mancusi*"), and in further view of U.S. Patent No. 4,800,019 ("*Bikson*") and U.S. Patent No. 4,961,760 ("*Caskey*").

Fifth, whether Claims 21-23, and 27 are obvious under 35 U.S.C. 103(a) over U.S. Patent No. 5,186,832 ("*Mancusi*") in view of U.S. Patent No. 4,800,019 ("*Bikson*"), and in further view of Applicants' admitted prior art.

Sixth, whether Claims 24-26 are obvious under 35 U.S.C. 103(a) over U.S. Patent No. 5,186,832 ("*Mancusi*") in view of U.S. Patent No. 4,800,019 ("*Bikson*"), and in further view of Applicants' admitted prior art and U.S. Patent No. 4,961,760 ("*Caskey*").

Seventh, whether Claims 21-24 and 26-27 are obvious under 35 U.S.C. 103(a) over U.S. Patent No. 5,284,584 ("*Huang*") in view of U.S. Patent No. 5,186,832 ("*Mancusi*"), and in further view of U.S. Patent No. 4,800,019 ("*Bikson*") and Applicants' admitted prior art.

Eighth, whether Claim 25 is obvious under 35 U.S.C. 103(a) over U.S. Patent No. 5,284,584 ("*Huang*") in view of U.S. Patent No. 5,186,832 ("*Mancusi*"), and in further view of U.S. Patent No. 4,800,019 ("*Bikson*") and Applicants' admitted prior art.

## **7. GROUPING OF THE CLAIMS**

Claims 1-2, and 16-19 stand together as a group. Claims 4-5 stand together as a group. Claims 21-27 stand together as a group.

## **8. ARGUMENT**

Claims 1-2, 4-5, 16-19, and 21-27, for the reasons explained hereinafter, are not obvious under 35 U.S.C. 103(a). Thus, the above-mentioned 103 rejections are improper, and they must be removed. The errors made by the Examiner are discussed after a discussion of the invention and the cited references.

### **a. THE INVENTION**

The instant invention is directed to a method of making a hollow fiber membrane contactor, which comprises two potting steps: a first potting step, and a second potting step, described hereinbelow in detail. These two potting steps are quintessential in formation of a seal, which is capable of overcoming the problems arising from potting shrinkage, specifically, in contactors with a diameter greater than 10 inches. Referring to instant specification and figures 2-4, the manufacture of the hollow fiber membrane contactor is illustrated below.

In figure 2, shown below, "center tube 12 is used as a mandrel. Hollow fiber fabric 16 is wound around tube 12. Simultaneously with winding, potting resin beads 36 are laid at the lateral edges of fabric 16 and form tube sheets 18, i.e., the first or bead-potting step. Optionally, a bead 38 may also be laid between beads 36, thereby forming spacer 34. At the conclusion of this step, the potting is, preferably, a gelatinous solid 37 and the unitized structure is formed.

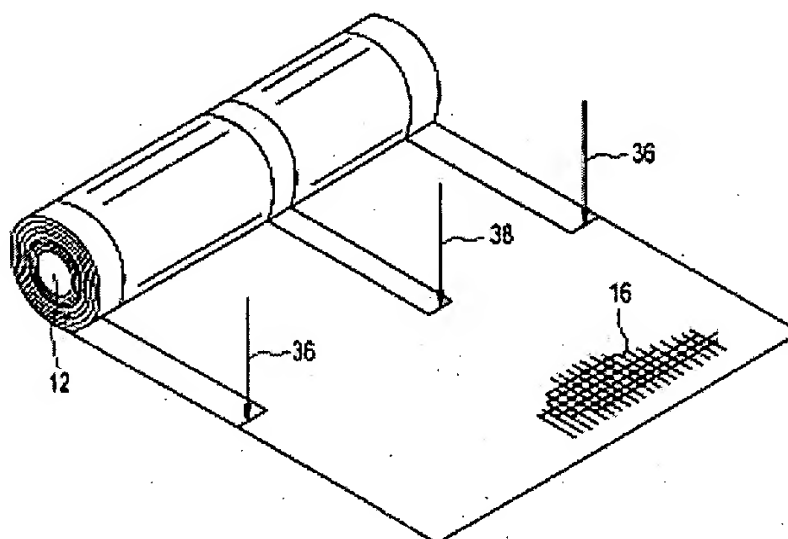


Fig.2

After the first potting step, the unitized structure is inserted into the shell 20. Shell 20 and the structure are inserted into a mold 42." (Specification, Page 7, Line 20 - Page 8 Line 6).

Referring to figure 3, "mold 42, preferably, consists of a part that engages shell 20, a center mold piece 44 that engages



tube 12, and potting injection ports 46. The mold thereby centers the unit within the shell." (Specification, Page 8, Lines 8-11).

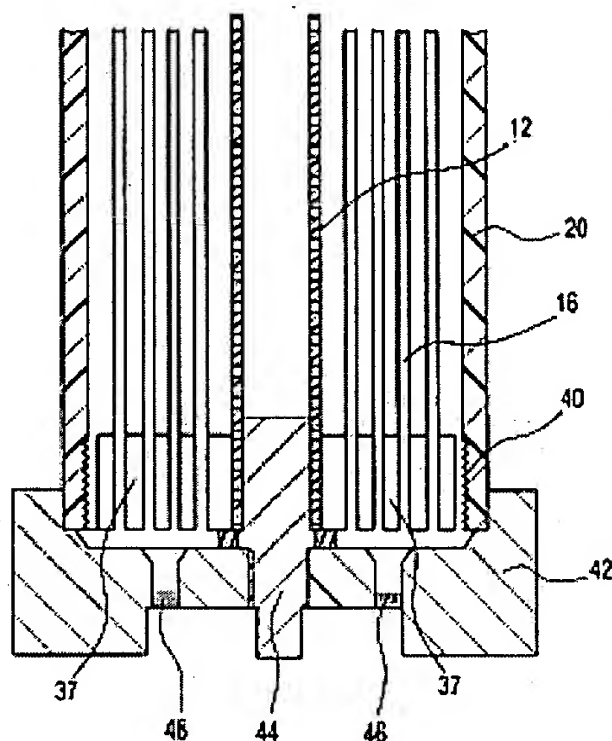


Fig. 3

Referring to figure 4, "a second potting material 48 is injected through the mold, into the space between shell 20 and solid 37, and thereby joins the shell to the unitized structure, i.e., the second or mold-potting step." (Specification, Page 8, Lines 13-18).

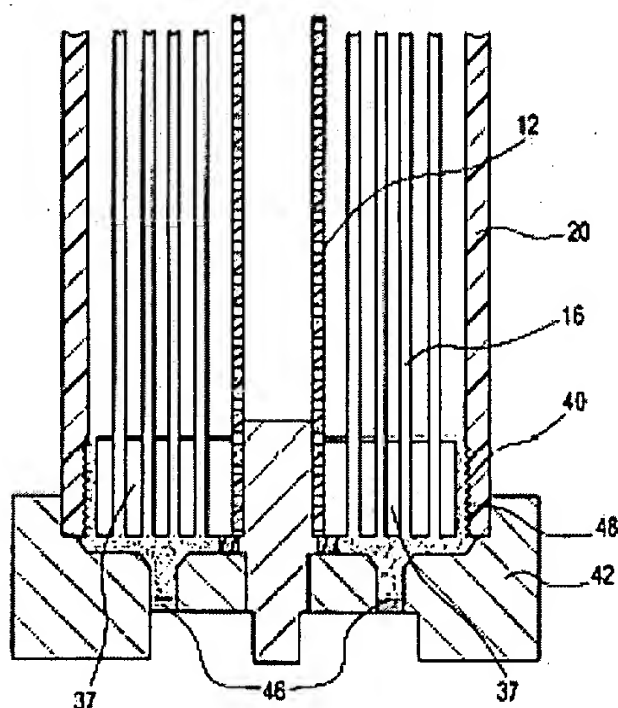


Fig. 4

"The potting resins are allowed to solidify. The cartridge is removed from the mold. The ends are, preferably, subjected to a rotary cut to open the end of the hollow fibers and to generate a planar cut surface that is perpendicular to the centerline of the cartridge." (Specification, Page 8, Lines 20-24).

"After the two potting steps described above, the cartridge is, preferably, heat-treated. Heat-treatment increases the thermal/mechanical integrity of the cartridge by reducing residual stress. Additionally, when an epoxy potting is used, this heat-treatment further cross-links and hardens the potting. Reduced stress lessens the occurrence of cracking at interfaces and joints." (Specification, Page 9, Lines 2-7).

According to the instant application, "although contactors with ten (10) inch diameter are commercially available, these contactors are difficult to seal because of potting shrinkage." (Specification, Page 2, Lines 10-13). The instant invention resolves the difficulties associated with formation of a seal between the tube sheets and the shell due to the potting shrinkage. Furthermore, as shown in Claim 21, the instant invention provides a hollow fiber membrane contactor with a diameter greater than six

inches while maintaining the integrity of the seal between the tube sheets and the shell.

b. CITED REFERENCES

U.S. Patent No. 5,186,832 ("*Mancusi*"), assigned to the real party in interest of the instant appeal, is directed to a spiral-type hollow fiber membrane fabric-containing cartridges and modules for separation and other phase contact applications. (Column 1, lines 13). According to *Mancusi*, (1) the hollow membrane fabric and integrally-bonded turbulence-promoting web is wound onto the surface of the hollow core mandrel to form a spirally-wound membrane bundle (Column 8, lines 44-47); (2) the two ends of the bundle are potted in resinous potting material serving to seal each of the bundle ends into a monolithic tube sheet and complete the cartridge (Column 9, lines 1-8); (3) one or both of the potted ends of the bundle are then trimmed so that the lumen ends of each hollow fiber at the trimmed end(s) will be exposed (Column 9, lines 14-17); (4) the potted bundle is fitted into a suitable housing to yield a module and facilitate operation (Column 9, lines 18-19); (5) the tube sheet(s) adjacent to the bundle end(s) with exposed lumens is(are) **sealed** to the interior of the housing, to positively prevent fluid flow between the shell side and the lumen side without passage through the membrane (Column 9, lines 23-27); and

(6) end cap means suitably shaped to seal each of the two open housing ends are provided (Column 9, lines 33-34).

Furthermore, according to *Mancusi*, cast-in-place modules can be made by the steps of: (1) starting with (a) a bundle prepared as discussed above, and (b) a conventional cast-in-place housing, which is generally made of plastic; (2) inserting the bundle into the housing; (3) potting both of the bundle ends after sealing the bundle ends with a potting cup clamped over each end of the housing; and (4) providing suitable end caps and ports. (Column 9, line 63 - Column 10, line 3).

However, *Mancusi* does not teach or suggest anything about employing a two potting steps method, as required by the instant invention to form a seal between the tube sheets and the shell. Furthermore, *Mancusi* does not teach or suggest anything about heat-treatment of the cartridge to cure the potting between the tube sheets and the shell in order to resolve the problems associated with the seal between the tube sheets and the shell, which is due to the shrinkage of the potting materials. Furthermore, the creation of seal between the tube sheets to the interior of the housing in *Mancusi* is, in fact, facilitated via the use of O-rings as shown in the declaration submitted by Charles J. Runkle (attached hereto as "Exhibit A").

U.S. Patent No. 4,800,019 ("*Bikson*") is directed to a method of producing a porous hollow semipermeable membrane device. (Column 3, lines 18-20). According to *Bikson*, one or both ends of a plurality or a bundle of porous hollow fibers is embedded or potted in a tube sheet. (Column 4, lines 48-51). According to *Bikson*, the end of the hollow fiber bundle is placed in a mold, and the mold is filled with the potting resin composition to form the tube sheets. (Column 4, lines 53-55). The tube sheet or potted portion of the module is subsequently heat treated by the process according to *Bikson*. (Column 4, lines 60-68). Heating is continued for a period of time sufficient to essentially densify the porous walls of the hollow fibers in the potted portion of the tube sheet. (Column 3, lines 28-30). As a consequence of this heat treatment, the hollow fiber in the tube sheet densifies and the bores of the portion of the hollow fibers embedded in the tube sheet now have a larger inside bore diameter than the inside bore diameter of the portion of the porous hollow fiber not embedded in the tube sheet. (Column 8, lines 27-33). In addition, the walls of the hollow fibers, embedded in the tube sheet, are now essentially fully dense and non-compressible. (Column 8, lines 33-36). The fibers will not shrink from the potting-fiber interface at operating pressures during fluid separation processes and there is essentially no leakage at the interface between the outside

surface wall of the hollow fibers and the tube sheet. (Column 8, lines 36-40). Also, because the inside diameter of the fiber bore openings has increased due to the hollow fiber wall densification, pressure drop through the bores in the tube sheet during fluid separation operation is lower. (Column 8, lines 40-44). Another advantage is that the opening of the fiber bore ends in the tube sheet is facilitated due to the larger bore openings present. (Column 8, lines 44-46).

However, *Bikson* does not teach or suggest anything about employing a two potting steps method, as required by the instant invention to form a seal between the tube sheets and the shell. Furthermore, *Bikson* does not teach or suggest anything about heat-treatment of the cartridge to cure the potting between the tube sheets and the shell in order to resolve the problems associated with the seal between the tube sheets and the shell, which is due to the shrinkage of the potting materials.

U.S. Patent No. 4,961,760 ("*Caskey*") is directed to hollow fiber membrane fluid separation device specially adapted for boreside feed. *Caskey* discloses that tube sheets may be made from a variety materials, i.e. epoxy, polyurethane, and acrylic resins. (Column 7, lines 40-43).

However, Caskey does not teach or suggest anything about employing a two potting steps method, as required by the instant invention to form a seal between the tube sheets and the shell. Furthermore, Caskey does not teach or suggest anything about heat-treatment of the cartridge to cure the potting between the tube sheets and the shell in order to resolve the problems associated with the seal between the tube sheets and the shell, which is due to the shrinkage of the potting materials.

U.S. Patent No. 5,284,584 ("*Huang*"), assigned to the real party in interest of the instant appeal, is directed to a method of fabricating a spiral-type hollow fiber membrane fabric-containing cartridge. (Column 4, lines 12-14). According to *Huang*, "(1) hollow fibers are fabricated into a fabric-like array; (2) the fabric-like array is wound onto the mandrel surface to form a spirally wound, cylindrical shape membrane bundle; (3) the ends of the membrane bundle is potted in resinous potting material serving to seal each of the bundle ends into a monolithic tube sheet; (4) the potted ends of the bundle is trimmed so that the lumen ends of each hollow fiber at the trim end is exposed; (5) potted bundle is fitted into a housing; and (6) the tube sheet(s) adjacent to the bundle end(s) with exposed lumens is(are) sealed to the cylindrical interior of the housing, to positively prevent fluid flow between

the shell side and the lumen side without passage through the membrane." (Column 7, line 6 - Column 9, line 16).

However, *Huang* does not teach or suggest anything about employing a two potting steps method, as required by the instant invention to form a seal between the tube sheets and the shell. Furthermore, *Huang* does not teach or suggest anything about heat-treatment of the cartridge to cure the potting between the tube sheets and the shell in order to resolve the problems associated with the seal between the tube sheets and the shell, which is due to the shrinkage of the potting materials. Furthermore, the creation of seal between the tube sheets to the interior of the housing in *Huang* is, in fact, facilitated via the use of O-rings as shown in the declaration submitted by Charles J. Runkle (attached hereto as "Exhibit A").

c. DISCUSSION OF THE EXAMINER'S ERROR

Claims 1-2, 4-5, 16-19, and 21-27 are not obvious under 35 U.S.C. 103(a) because the Examiner has failed to show a *prima facie* case of obviousness.

To reject claims in an application under section 103, an examiner must show a *prima facie* case of obviousness. *In re Deuel*,



51 F. 3d 1552, 1557 (Fed. Cir. 1995). All words in a claim must be considered in judging the patentability of that claim against prior art. *In re Wilson*, 424 F.2d 1382, 1385 (CCPA 1970). Furthermore, to establish a *prima facie* case of obviousness, the following three basic elements must be met: (1) there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings; (2) the prior art reference or references when combined must teach or suggest all the claim limitations; **and** (3) there must be a reasonable expectation of success. MPEP § 2143. In addition, if the proposed modification or combination of the prior art would change the principle operation of the prior art invention being modified, then teachings of the references are not sufficient to render the claims *prima facie* obvious. *In re Ratti*, 270 F.2d 810 (CCPA 1959). Finally, if an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F. 2d 1071 (Fed. Cir. 1988).

The Examiner has failed to show a *prima facie* case of obviousness for the reasons explained hereinafter.

With regard to the first issue, the Examiner has failed to show all of the elements required to establish a *prima facie* case of obviousness.

First, with regard to Claim 1, there is no suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify *Mancusi* or to combine the *Mancusi's* teachings with *Bikson's* teachings for the reasons explained hereinafter.

The instant invention is directed to a method of making a hollow fiber membrane which includes, as stated above, a two potting steps method, wherein a seal is formed between the structure and the shell via injecting a potting material into a space between the structure and the shell. The instant invention provides a solution to the shortcomings of the prior art, specifically, the instant invention minimizes the problems associated with the shrinkage arising from the solidification of the potting materials in the tube sheets. Therefore, the instant invention, as shown in Claim 21, facilitates the production of membrane contactors having a diameter of six (6) inches or more.

However, although *Mancusi*, as stated above, discloses that "the tube sheet(s) adjacent to the bundle end(s) with exposed

lumens is(are) **sealed** to the interior of the housing, *Mancusi* fails to teach or suggest anything about employing a two potting steps method, as required by the instant invention, to form a seal between the tube sheets and the shell. In fact, the creation of seal between the tube sheets to the interior of the housing in *Mancusi* is facilitated via the use of O-rings as shown in the declaration submitted by Charles J. Runkle (attached hereto as "Exhibit A").

Furthermore, *Bikson* only discloses mold potting in connection with forming the tube sheets (first potting); however, the Examiner has misconstrued *Bikson* to show that it teaches the formation of a seal between the tube sheets and the shell (second potting). There is no mention in *Bikson* about employing a two potting steps method, as required by the instant invention, to form a seal between the tube sheets and the shell. *Bikson* is simply directed to heat treatment of the tube sheets to densify the porous walls of the hollow fibers in the potted portion of the tube sheet in order to enlarge the diameter of the lumen portion of the fibers embedded in the tube sheets than the diameter of the lumen portion of the fibers not embedded in the tube sheets.

Similar to *Ex parte Levengood*, 28 USPQ 2D 1300 (Bd. Pat. App. & Inter., 1993), where the suggestion for examiner's combination

improperly stemmed from the applicant's disclosure, the suggestion for Examiner's combination of the prior art, with regard to the instant application, also stems from the Applicant's disclosure in the instant application. Although, *Mancusi* teaches the requirement for a seal between the tube sheets and the shell, and *Bikson* discloses the use of mold potting to form the tube sheets, there is no suggestions or motivations to modify *Mancusi*'s teachings or to combine *Mancusi*'s teachings with *Bikson*'s teachings, i.e. to employ a two potting steps method, as required by the instant invention, to form a seal between the tube sheets and the shell.

Therefore, Claim 1 is not obvious since all of the required elements to establish a *prima facie* case of obviousness has not been shown.

Second, with regard to Claim 1, the proposed combinations would change the principle of operation of *Mancusi*, sealing step via the use of O-rings, assuming, *arguendo*, *Mancusi* and *Bikson* are combinable. *Mancusi*, as shown in "Exhibit A," employs the use of O-rings to form the seal while the instant invention employs a two potting steps method to form a seal. Formation of a seal via O-rings is fundamentally different from formation of a seal via a two potting steps method. O-rings causes the shell to contract in order to form the seal while a two potting steps method forms the

seal via bonding. Therefore, the substitution of a two potting steps method as the means for forming the seal for O-rings would substantially change the principle operation of *Mancusi*; thus, the teachings of *Mancusi* and *Bikson* are not sufficient to render the instant claim obvious.

Third, with regard to claims 2, 4-5, 19, since Claim 1 is not obvious; then, Claims 2, 4-5, 19 are not obvious. Claims 2, 4-5, 19-20 are dependant claims from Claim 1. Furthermore, as mentioned hereinabove, if an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F. 2d 1071 (Fed. Cir. 1988). Therefore, Claims 2, 4-5, 19 are not obvious.

Fourth, with regard to Claim 4, Claim 4 also includes the heat treatment step in order to strengthen the seal between the tube sheets and the shell. According to instant invention, the heat treatment is a subsequent step to the two potting steps in order to strengthen the seal between the tube sheets and the shell. However, *Bikson*, as stated above, employs heat treatment after the first potting step in order to densify the walls of the hollow fibers, and to enlarge the diameter of the lumen of that portion of hollow fibers embedded in potting materials. Therefore, assuming, *arguendo*, *Mancusi* and *Bikson* are combinable, their teachings do not

teach or suggest all the claim limitations of Claim 4. Therefore, Claim 4 is not obvious.

With regard to the second issue, since Claim 1 is not obvious; then, Claims 16-18 are not obvious. Claim 16 is a dependant claim from Claim 1, and Claims 17 and 18 are dependant claims from Claim 16. Furthermore, as mentioned hereinabove, if an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F. 2d 1071 (Fed. Cir. 1988). Therefore, Claims 16-18 are not obvious.

With regard to the third issue, the Examiner has failed to show all of the elements required to establish a *prima facie* case of obviousness.

First, with regard to Claim 1, there is no suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify *Huang's* teachings or to combine *Huang's* teachings with the teachings of *Mancusi* and *Bikson* for the reasons explained hereinafter.

The instant invention, as mentioned hereinabove, is directed to a method of making a hollow fiber membrane which includes, as

stated above, a two potting steps method, wherein a seal is formed between the structure and the shell. The instant invention provides a solution to the shortcomings of the prior art, specifically, the instant invention minimizes the problems associated with the shrinkage arising from the solidification of the potting materials in the tube sheets. Therefore, the instant invention facilitates, as shown in Claim 21, the production of membrane contactors having a diameter of six (6) inches or more.

According to *Huang*, the tube sheet(s) adjacent to the bundle end(s) with exposed lumens is(are) sealed to the cylindrical interior of the housing, to positively prevent fluid flow between the shell side and the lumen side without passage through the membrane." (Column 7, line 6 - Column 9, line 16). However, *Huang* does not teach or suggest anything about employing a two potting steps method, as required by the instant invention, to form a seal between the tube sheets and the shell. In fact, the creation of seal between the tube sheets to the interior of the housing in *Huang* is facilitated via the use of O-rings as shown in the declaration submitted by Charles J. Runkle ("Exhibit A").

Furthermore, although *Mancusi*, as stated above, discloses that "the tube sheet(s) adjacent to the bundle end(s) with exposed lumens is(are) **sealed** to the interior of the housing, *Mancusi* fails

to teach or suggest anything about employing a two potting steps method, as required by the instant invention, to form a seal between the tube sheets and the shell. In fact, the creation of seal between the tube sheets to the interior of the housing in *Mancusi* is facilitated via the use of O-rings as shown in the declaration submitted by Charles J. Runkle ("Exhibit A").

In addition, *Bikson* only discloses mold potting in connection with forming the tube sheets (first potting); however, the Examiner has misconstrued *Bikson* to show that it teaches the formation a seal between the tube sheets and the shell (second potting). There is no mention in *Bikson* about employing a two potting steps method, as required by the instant invention, to form a seal between the tube sheets and the shell. *Bikson* is simply directed to heat treatment of the tube sheets to densify the porous walls of the hollow fibers in the potted portion of the tube sheet in order to enlarge the diameter of the lumen portion of the fibers embedded in the tube sheets than the diameter of the lumen portion of the fibers not embedded in the tube sheets.

Similar to *Ex parte Levengood*, 28 USPQ 2D 1300 (Bd. Pat. App. & Inter., 1993), where the suggestion for examiner's combination improperly stemmed from the applicant's disclosure, the suggestion for Examiner's combination of the prior art, with regard to the



instant application, also stems from the Applicant's disclosure in the instant application. Although, *Huang* and *Mancusi* disclose the requirement for a seal between the tube sheets and the shell, and *Bikson* discloses the use of mold potting to form the tube sheets, there is no suggestions or motivations to Modify *Huang's* teachings or to combine *Huang's* teachings with *Mancusi's* teachings and *Bikson's* teachings, i.e. to employ a two potting steps method, as required by the instant invention, to form a seal between the tube sheets and the shell.

Therefore, Claim 1 is not obvious since all of the required elements to establish a *prima facie* case of obviousness has not been shown.

Second , with regard to claims 2, 4-5, 16, 18-19, since Claim 1 is not obvious; then, Claims 2, 4-5, 16, 18-19 are not obvious. Claims 2, 4-5, 16, 18-19 are dependant claims from Claim 1. Furthermore, as mentioned hereinabove, if an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F. 2d 1071 (Fed. Cir. 1988). Therefore, Claims 2, 4-5, 16, 18-19 are not obvious.

Third, with regard to Claim 4 and Claim 5, Claim 4 and Claim 5 also include the heat treatment step in order to strengthen the

seal between the tube sheets and the shell. According to instant invention, the heat treatment is a subsequent step to the two potting steps method to strengthen the seal between the tube sheets and the shell. However, *Bikson*, as stated above, employs heat treatment after the first potting step in order to densify the walls of the hollow fibers, and to enlarge the diameter of the lumen of that portion of hollow fibers embedded in potting materials. Therefore, assuming, arguendo, *Mancusi* and *Bikson* are combinable, their teachings do not teach or suggest all the claim limitations of Claim 4 or Claim 5. Therefore, Claim 4 and Claim 5 are not obvious.

With regard to the fourth issue, since Claim 1 and Claim 16 are not obvious; then, Claim 17 is not obvious. Claim 16 is a dependant claim from Claim 1, and Claim 17 is a dependant claim from Claim 16. Furthermore, as mentioned hereinabove, if an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F. 2d 1071 (Fed. Cir. 1988). Therefore, Claim 17 is not obvious.

With regard to the fifth issue, Claims 21-23, and 27 are not obvious for the reasons stated herein below.

First, with regard to Claim 21, Claim 21 is further limited in scope than Claim 1; in Claim 21, the center tube has a diameter of 6 inches or more, and the first potting step is accomplished via bead potting. Therefore, for the reasons stated hereinabove with regard to Claim 1 in response to the first issue, Claim 21 is not obvious either.

Second, with regard to Claims 22-23, and 27, since Claim 21 is not obvious; then, Claims 22-23, and 27 are not obvious. Claims 22 and 27 are dependant claims from Claim 21, and Claim 23 is a dependant claim from Claim 22. Furthermore, as mentioned hereinabove, if an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F. 2d 1071 (Fed. Cir. 1988). Therefore, Claims 22-23, and 27 are not obvious.

With regard to sixth issue, since Claim 21 is not obvious; then, Claims 22-26 are not obvious. Claim 22 and 24 are dependant claims from Claim 21, and Claims 23, 25, and 26 are dependant claims from Claim 22 and 24. Furthermore, as mentioned hereinabove, if an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F. 2d 1071 (Fed. Cir. 1988). Therefore, Claims 22-26 are not obvious.

With regard to seventh issue, Claims 21-24, and 26-27 are not obvious for the reasons stated herein below.

First, with regard to Claim 21, Claim 21 is further limited in scope than Claim 1; in Claim 21, the center tube has a diameter of 6 inches or more, and the first potting step is accomplished via bead potting. Therefore, for the reasons stated hereinabove with regard to Claim 1 in response to the third issue, Claim 21 is not obvious either.

Second, with regard to Claims 22-24, and 26-27, since Claim 21 is not obvious; then, Claims 22-24, and 26-27 are not obvious. Claims 22, 24, and 27 are dependant claims from Claim 21, and Claims 23, and 26 are dependant claims from Claim 22, and 24, respectively. Furthermore, as mentioned hereinabove, if an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F. 2d 1071 (Fed. Cir. 1988). Therefore, Claims 22-24, and 26-27 are not obvious.

With regard to eighth issue, since Claim 21 and 24 are not obvious; then, Claim 25 is not obvious. Claim 24 is a dependant claim from Claim 21, and Claim 25 is a dependant claim from Claim

24. Furthermore, as mentioned hereinabove, if an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F. 2d 1071 (Fed. Cir. 1988). Therefore, Claims 25 is not obvious.

d. CONCLUSION

In view of the forgoing comments, Claims 1-2, 4-5, 16-19, and 21-27 are not obvious under 35 U.S.C. 103(a); therefore, the Applicant respectfully requests an early Notice of Allowance in the instant application.

Respectfully submitted,



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Docket No. 2000.16  
SERIAL NO. 09/851,242  
ART UNIT 1732

APPENDIX

1. A method of making a hollow fiber membrane contactor comprising the steps of:  
  
winding a hollow fiber fabric around a center tube,  
  
first potting the fabric and the tube together,  
  
forming thereby a unitized structure,  
  
placing the structure into a shell,  
  
second mold potting the structure and the shell together by injecting a potting material into a space between the structure and the shell, and  
  
forming thereby a cartridge.
2. The method of claim 1 wherein the first-mentioned potting being bead potting.
4. The method of claim 1 further comprising the step of heat-treating the cartridge.

5. The method of claim 4 wherein the heat-treating further comprises a first heat-treating and a second heat-treating.

16. The method of claim 1 wherein potting further comprises the first or the second potting with a material selected from the group consisting of thermosetting materials and thermoplastic materials.

17. The method of claim 16 wherein the thermosetting material being selected from the group consisting of epoxy and polyurethane.

18. The method of claim 16 wherein the thermoplastic material being selected from the group consisting of polyolefins and polyurethanes.

19. The method of claim 1 wherein placing the structure into a shell further comprises centering the structure in the shell.

21. A method of making a hollow fiber membrane contactor comprising the steps of:

winding a hollow fiber fabric around a center tube to a diameter of at least six inches,  
bead potting the fabric and the tube together,  
forming thereby a unitized structure,  
placing the structure into a shell,  
mold potting the structure and the shell together by injecting a potting material into a space between the structure and the shell, and  
forming thereby a cartridge.

22. The method of claim 21 further comprising the step of heat-treating the cartridge.

23. The method of claim 22 wherein the heat-treating further comprises a first heat-treating and a second heat-treating.

24. The method of claim 21 wherein bead or mold potting further comprises using a material selected from the group consisting of thermosetting materials and thermoplastic materials.



25. The method of claim 24 wherein the thermosetting material being selected from the group consisting of epoxy and polyurethane.

26. The method of claim 24 wherein the thermoplastic material being selected from the group consisting of polyolefins and polyurethanes.

27. The method of claim 21 wherein placing the structure into a shell further comprises centering the structure in the shell.

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# EXHIBIT A

Attorney Docket No. 2000.16

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:  
Runkle, et al

Art Unit: 1732

Serial No. 09/851,242

Examiner: S. Staicovici

Filed: May 8, 2001

For: HOLLOW FIBER MEMBRANE CONTACTOR  
AND METHOD FOR MAKING SAME

## DECLARATION UNDER RULE 132

I, Charles J. Runkle, declare:

1. I am a named inventor in the above captioned application.
2. I am also a named inventor in U.S. Patent Numbers 5,186,832 (Mancusi et al) and 5,284,584 (Huang et al) cited against the above captioned application.
3. In the instant application, Paper No. 6, page 4, paragraph 9, and page 6, paragraph 12, the Examiner states:  
  
"...., it should be noted that Mancusi et al ('832) specifically teach potting of the tube-sheets to the interior of the housing (see col. 9, lines 22-27)."
4. The Examiner's interpretation of that portion of Mancusi et al is incorrect.

5. The portion of Mancusi *et al* cited by the Examiner states:

"After the bundle is installed in the housing, the tube sheet(s) is (are) sealed to the interior of the housing, to positively prevent fluid flow between the shell side and the lumen side without passage through the membrane."

6. That portion does not refer to "potting the structure and the shell together."

7. That portion refers to the use of o-rings to form a seal.

8. The portion of Mancusi *et al* cited by the Examiner and set out in Paragraph 5 above appears in Huang *et al* at column 9, lines 11-16.

9. Therein, it is stated that the "bundle" is "sealed" to the "housing."

10. In that passage, "sealed" refers to the use of o-rings.

11. At Huang *et al*, column 21, lines 58-61 and Figure 6, it is shown that "sealing" refers to o-rings.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and that these statements were made

with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Respectfully submitted,

Charles J. Runkle

E:\FIRMDOCS\2000\016\RunkleDeclaration.doc

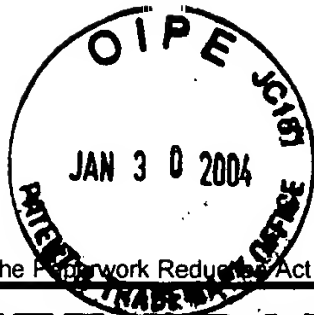


Image # AF/1732

PTO/SB/17 (10-03)

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# FEE TRANSMITTAL for FY 2004

Effective 10/01/2003. Patent fees are subject to annual revision.

☐ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT (\$)  
330.00

## Complete if Known

Application Number	09/851,242
Filing Date	May 8, 2001
First Named Inventor	Charles J. Runkle
Examiner Name	S. Staicovici
Art Unit	1732
Attorney Docket No.	2000.16

## METHOD OF PAYMENT (check all that apply)

☐ Check ☐ Credit card ☐ Money Order ☐ Other ☐ None

☒ Deposit Account:

Deposit  
Account  
Number  
Deposit  
Account  
Name

08-2447

Robert H. Hammer III, P.C.

The Director is authorized to: (check all that apply)

☒ Charge fee(s) indicated below ☒ Credit any overpayments

☐ Charge any additional fee(s) or any underpayment of fee(s)

☐ Charge fee(s) indicated below, except for the filing fee to the above-identified deposit account.

## FEE CALCULATION

### 1. BASIC FILING FEE

Large Entity		Small Entity		Fee Description	Fee Paid
Fee Code	Fee (\$)	Fee Code	Fee (\$)		
1001	770	2001	385	Utility filing fee	
1002	340	2002	170	Design filing fee	
1003	530	2003	265	Plant filing fee	
1004	770	2004	385	Reissue filing fee	
1005	160	2005	80	Provisional filing fee	
SUBTOTAL (1) (\$)					

### 2. EXTRA CLAIM FEES FOR UTILITY AND REISSUE

Total Claims  -20\*\* =  X  =   
Independent Claims  -3\*\* =  X  =   
Multiple Dependent  =

Large Entity		Small Entity		Fee Description
Fee Code	Fee (\$)	Fee Code	Fee (\$)	
1202	18	2202	9	Claims in excess of 20
1201	86	2201	43	Independent claims in excess of 3
1203	290	2203	145	Multiple dependent claim, if not paid
1204	86	2204	43	** Reissue independent claims over original patent
1205	18	2205	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) (\$)

\*\*or number previously paid, if greater; For Reissues, see above

## FEE CALCULATION (continued)

### 3. ADDITIONAL FEES

Large Entity Small Entity

Fee Code	Fee (\$)	Fee Code	Fee (\$)	Fee Description	Fee Paid
1051	130	2051	65	Surcharge - late filing fee or oath	
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet	
1053	130	1053	130	Non-English specification	
1812	2,520	1812	2,520	For filing a request for ex parte reexamination	
1804	920*	1804	920*	Requesting publication of SIR prior to Examiner action	
1805	1,840*	1805	1,840*	Requesting publication of SIR after Examiner action	
1251	110	2251	55	Extension for reply within first month	
1252	420	2252	210	Extension for reply within second month	
1253	950	2253	475	Extension for reply within third month	
1254	1,480	2254	740	Extension for reply within fourth month	
1255	2,010	2255	1,005	Extension for reply within fifth month	
1401	330	2401	165	Notice of Appeal	
1402	330	2402	165	Filing brief in support of an appeal	330.00
1403	290	2403	145	Request for oral hearing	
1451	1,510	1451	1,510	Petition to institute a public use proceeding	
1452	110	2452	55	Petition to revive - unavoidable	
1453	1,330	2453	665	Petition to revive - unintentional	
1501	1,330	2501	665	Utility issue fee (or reissue)	
1502	480	2502	240	Design issue fee	
1503	640	2503	320	Plant issue fee	
1460	130	1460	130	Petitions to the Commissioner	
1807	50	1807	50	Processing fee under 37 CFR 1.17(q)	
1806	180	1806	180	Submission of Information Disclosure Stmt	
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	
1809	770	2809	385	Filing a submission after final rejection (37 CFR 1.129(a))	
1810	770	2810	385	For each additional invention to be examined (37 CFR 1.129(b))	
1801	770	2801	385	Request for Continued Examination (RCE)	
1802	900	1802	900	Request for expedited examination of a design application	

Other fee (specify) \_\_\_\_\_

\*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) (\$)  
330.00

## SUBMITTED BY

Name (Print/Type)	Robert H. Hammer III	Registration No. (Attorney/Agent)	31,764	Telephone	704-927-0400
Signature		Date	January 28, 2004		

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